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**The Parasitic Crustaceans of Fishes from the Brazilian Amazon,
16, *Amazonicopeus elongatus* gen. et sp. nov. (Copepoda: Poecilostomatoida)
with the Proposal of Amazonicopeidae fam. nov. and
Remarks on its Pathogenicity**

by

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Abstract

The post-metamorphic female of *Amazonicopeus elongatus* gen. et sp. nov. (Copepoda: Poecilostomatoida) is described and Amazonicopeidae fam. nov. is proposed to contain this parasite. The new form was found on the gill arches of *Plagioscion squamosissimus* (HECKEL) from the Amazon River near Manaus, Brazil. The new family is unique in having a head with eyes, but no cephalothorax, an elongate neck formed from head segments, a mouth distant from the head, located on the hindbody, a protrusible mouth-tube and a divided abdomen with two free segments attached to each uropod. These parasites burrow in to grasp the gill arch with their antennae. This penetration provokes an inflammatory reaction on the part of the host leading to cellular growth around the neck, followed by fibrotic encapsulation and eventual calcification.

Keywords: Gill parasite, copepod, new family, fishes, Amazon.

Resumo

A fêmea pós-metamórfica de *Amazonicopeus elongatus* gen. et sp. nov. (Copepoda: Poecilostomatoida) é descrita e Amazonicopeidae fam. nov. é proposta para conter este parasita. A nova forma foi encontrada nos arcos branquiais de *Plagioscion squamosissimus* (HECKEL) capturado no Rio Amazonas próximo à Manaus, Brasil. A nova família distingue-se por possuir uma cabeça com olhos, carecendo de um cefalotórax, um pescoço alongado formado de segmentos da cabeça, uma boca distante da cabeça situada na parte posterior do corpo, um tubo bucal prostrátil e um abdome dividido, sendo dois segmentos livres juntos com cada urópodo. Estes parasitas fazem um tunel até o arco branquial o qual agarram com as antenas. A penetração do parasita provoca uma reação inflamatória por parte do hospedeiro com um crescimento de células ao redor do pescoço seguido por encapsulação fibrótica e eventualmente calcificação.

Introduction

Metamorphosis in parasitic copepods, in which the adult female continues to grow without moulting and reaches an unusual size and form, is a common feature in Cyclopoida (Lernaeidae) and in many Siphonostomatoida. This phenomenon represents a phylogenetic advance in terms of adaptation to parasitism and probably enables the female parasite to have a longer reproductive period. Apparently, post-metamorphic females have not been reported for Poecilostomatoida. The present study describes such a female and proposes a new genus and family for this form. The only post-metamorphic female previously reported from the Amazon is the lernaeid recently described by THATCHER & PAREDES (1985).

Material and Methods

Infested gill arches were fixed in AFA (alcohol-formalin-acetic acid) and the parasites were later dissected from them with needles. Permanent study slides were prepared by the fenol-fuchsin-balsam method explained in THATCHER & BOEGER (1984). Coloration was determined by reference to SMITHE (1974). Drawings were made with the aid of a camera lucida and measurements in micrometers (μm) with a measuring ocular.

Systematic Section

Copepoda
Poecilostomatoida KABATA, 1979
Amazonicopeidae fam. nov.

Family diagnosis: Poecilostomatoida. Female (post-metamorphic): Body composed of head, neck and thoraco-abdomen. Head well developed, with two pigmented eyes (sometimes absent) and two pairs of antennae; head sclerite with or without lateral retropines. Neck long, slender; between antennae and mouth. Thoraco-abdomen: thorax of four leg-bearing segments; abdomen fused to genital segment, except for two small free segments on either side preceding uropods; uropods with few terminal setae. Antennule 4 or 5 segmented, with simple setae. Antenna 3-segmented; terminal segment a stout claw. Mouth: located in anterior portion of hindbody (thoraco-abdomen); mandible 2-segmented, with palp; maxillule with medial spine; maxilla 2-segmented; protrusible mouth-tube present, which can extend between and beyond mandibles and maxillae. Legs: four pairs present on hindbody; fourth exopod 2-segmented, all other rami 3-segmented. Egg sac multiseriate. Gill arch parasites of fish. Pre-metamorphic female: unknown. Male: unknown, but presumably free-living. Type genus: *Amazonicopeus* gen. nov.

Amazonicopeus gen. nov.

Generic diagnosis: Amazonicopeidae, with the characters of the family. Female (post-metamorphic): parasitic on Amazonian sciaenid fish. Pre-metamorphic female and male unknown.

Type species: *Amazonicopeus elongatus* gen. et sp. nov.

Amazonicopeus elongatus gen. et sp. nov.

Host: *Plagioscion squamosissimus* (HECKEL).

Site: Gill arches.

Locality: Amazon River, near Manaus, Amazonas, Brazil.

Holotype (female): Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

Paratypes: INPA and University of Nebraska State Museum, Lincoln, Nebraska.

Male: Unknown.

Etymology: In outline, the new genus resembles the shape of the canoe paddle traditionally made and used by Amazonian Indians. The name combines the name of the region with the Greek "kope" meaning oar or handle.

Species diagnosis (based on 17 specimens studied and 10 measured; Tables 1 and 2): Female: Body divisible into head, neck and hindbody (Fig. 1). Head (Figs. 7 and 12): provided with two eyes of smalt blue (color 70 of SMITHE, 1974) and two pairs of antennae; dorsal sclerite with small posterolateral retropines. Neck: slender, cylindrical, elongate; representing 3/4 to 4/5 of total body length. Hindbody (= thoraco-abdomen): cylindrical, tapering towards extremities; divided into four segments, with first bearing mouth and two pairs of legs, second and third each with a pair of legs and fourth incorporating genital segment and first abdominal segment and bearing egg sacs (Fig. 3); few scattered smalt blue pigment granules sometimes present, especially near mouth.

Antennule (Fig. 4): five-segmented, provided with few simple setae; setal formula = 1 : 2 : 0 : 1 : 4. Antenna (Fig. 2): three-segmented; first segment short, simple; second segment somewhat longer than first, with prominent medial spine; third segment claw-like, with two simple sensilla.

Mouthparts (Figs. 6, 8 and 15): mandible 2-segmented, with palp projecting from basal segment; terminal mandibular segment and palp both bristled posteriorly; maxillule small, with medial spine; maxilla 2-segmented, with bristled tip; retractable mouth-tube present.

Legs (Figs. 9 - 11): four pairs present on hindbody; all rami 3-segmented except for fourth exopod which has two segments; setae and spines as shown in figures and indicated in Table 3.

Abdomen (Fig. 5): first segment fused to genital segment; each uropod is preceded by two small segments that may represent remnants of abdominal segments 2 and 3; uropod with few terminal spinules and two simple setae.

Egg sac (Figs. 1 and 3): elongate, multiseriate, cylindrical.

Pathogenicity

These copepods tunnel through the soft tissues of the gill arch to reach the cartilaginous support which they grasp with the antennae. As the head penetrates, the neck region lengthens so that the hindbody remains outside and adjacent to the gill filaments. The penetration of the head provokes an inflammatory reaction on the part of the fish which extends an epithelial mass out over the entire neck. There is fibrotic encapsulation of the head and neck, followed gradually by calcification (Fig. 13). The host sometimes succeeds in destroying the head and neck of the parasite (Fig. 14), but even then, the latter may remain alive and reproductive for awhile. The hindbody of the specimen shown in Fig. 14 was alive and had egg sacs although the head and half of the neck had been destroyed by host reaction. The mode of feeding of these parasites could not be determined exactly, but they may ingest epithelial or blood cells from either the tumoroid growth surrounding the neck, or from nearby gill filaments. In either case, it is necessary for them to extend their mouth tubes into such tissues since the entire hindbody, where the mouth is located, hangs free of the gill filaments. The legs are too small in relation to the body to be of much use in grasping a gill filament. In one specimen a small hole was observed in a gill filament near the mouth of the parasite that may have been caused by insertion of the mouth tube. An extended mouth tube was seen in several specimens and in a few a small tube was seen projecting from it (Figs. 3 and 6). The small tube may conduct digestive enzymes into the fish tissues to promote external digestion of them.

Discussion

Amazonicopeidae fam. nov. differs from the known families of parasitic copepods in the following ways: 1) there is a distinct head, but there is no cephalothorax, 2) the elongate neck is formed of head segments only and does not contain any thoracic elements, 3) the mouth is located at a considerable distance from the head, is on the hindbody and therefore external to the host tissues, 4) in addition to the poecilostome mouthparts, there is a protrusible mouth-tube which probably represents an extension of the esophagus, and 5) the last two abdominal segments are divided longitudinally to accompany the uropod on each side.

The copepod head is thought to have arisen from the fusion of five or six segments and the primitive appendages of those segments were modified to form, respectively: antennules, antennae, mandibles, maxillules, maxillae and maxillipeds. The thoracic segments are marked by the presence of swimming legs. In post-metamorphic females that have a neck-like anterior extension for penetration, the neck is formed of elongate thoracic segments as evidenced by the retention of swimming legs on this structure. Even in these forms, a cephalothorax is usually present at the anterior end. The mouth in these penetrating forms is in the anterior part so that they can feed on host tissues or blood. Some of them actually insert the head and mouth within a major blood vessel and suck blood directly. Thus, penetrating host tissues provides both a means of attachment and a food supply. *Amazonicopeus* gen. nov., on the other hand, appears to gain only security by penetrating the head to the cartilage or bone of a gill arch and grasping this with its antennae. That the neck is composed entirely of head segments is indicated by the fact that this elongate structure lies between the antennae and mandibles.

Amazonicopeidae fam. nov. may have originated from ergasiloid stock. Morphological features that suggest this are: 1) the antennules and antennae are of similar form, 2) there are blue eyes in the head and scattered blue pigment granules in the hindbody, 3) except for the protrusible mouth-tube, the mouthparts are similar and maxillipeds are lacking, and 4) the thorax shows segmentation. Lernaeids and other copepods that bury their heads in host tissue usually have no eyes. The presence of these redundant organs may indicate a relatively recent origin of the group.

References

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Table 1: Measurements (μm) of 10 adult females of *Amazonicopeus elongatus* gen. et sp. nov.

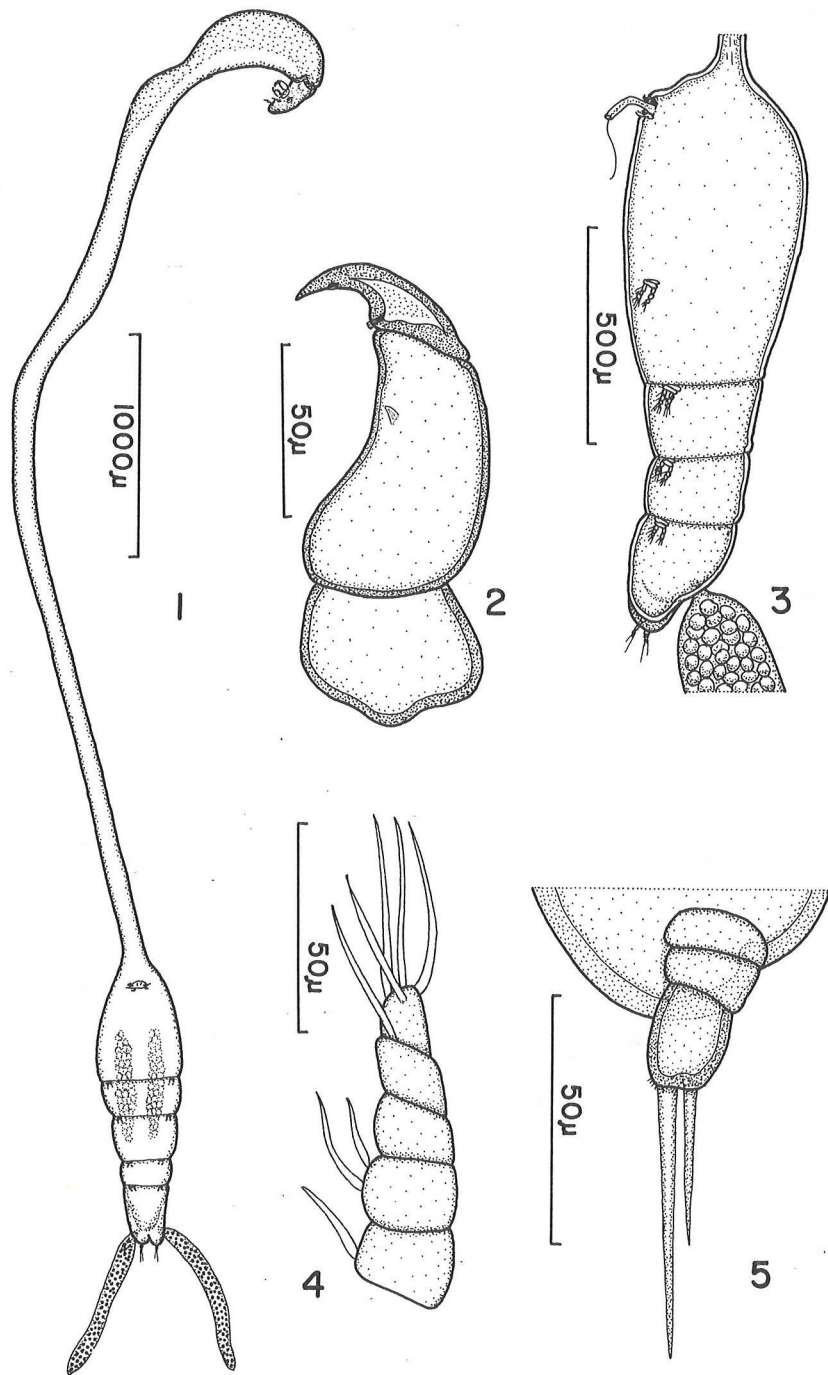
	Length	Width
Body	2,400 - 7,300 (5,560)	300 - 460 (399)
Thoraco-abdomen	875 - 1,500 (1,168)	300 - 460 (399)
Head	180 - 200 (168)	100 - 180 (168)
Neck	--	47 - 320 (160)
Thoracic Segments		
III	235 - 713 (532)	330 - 470 (426)
IV	125 - 263 (169)	210 - 410 (322)
V	100 - 197 (147)	180 - 330 (280)
Genito-abdomen	150 - 375 (237)	160 - 270 (212)
Abdominal Segments		
II	7 - 13 (9)	15 - 38 (23)
III	8 - 13 (11)	19 - 28 (23)
Uropod	20 - 23 (22)	13 - 20 (17)
Caudal Setae	50 - 137 (93)	--
Egg Sac	400 - 1,100 (794)	100 - 180 (133)

Table 2: Antennal measurements (μm) of 10 adult females of *Amazonicopeus elongatus* gen. et sp. nov.

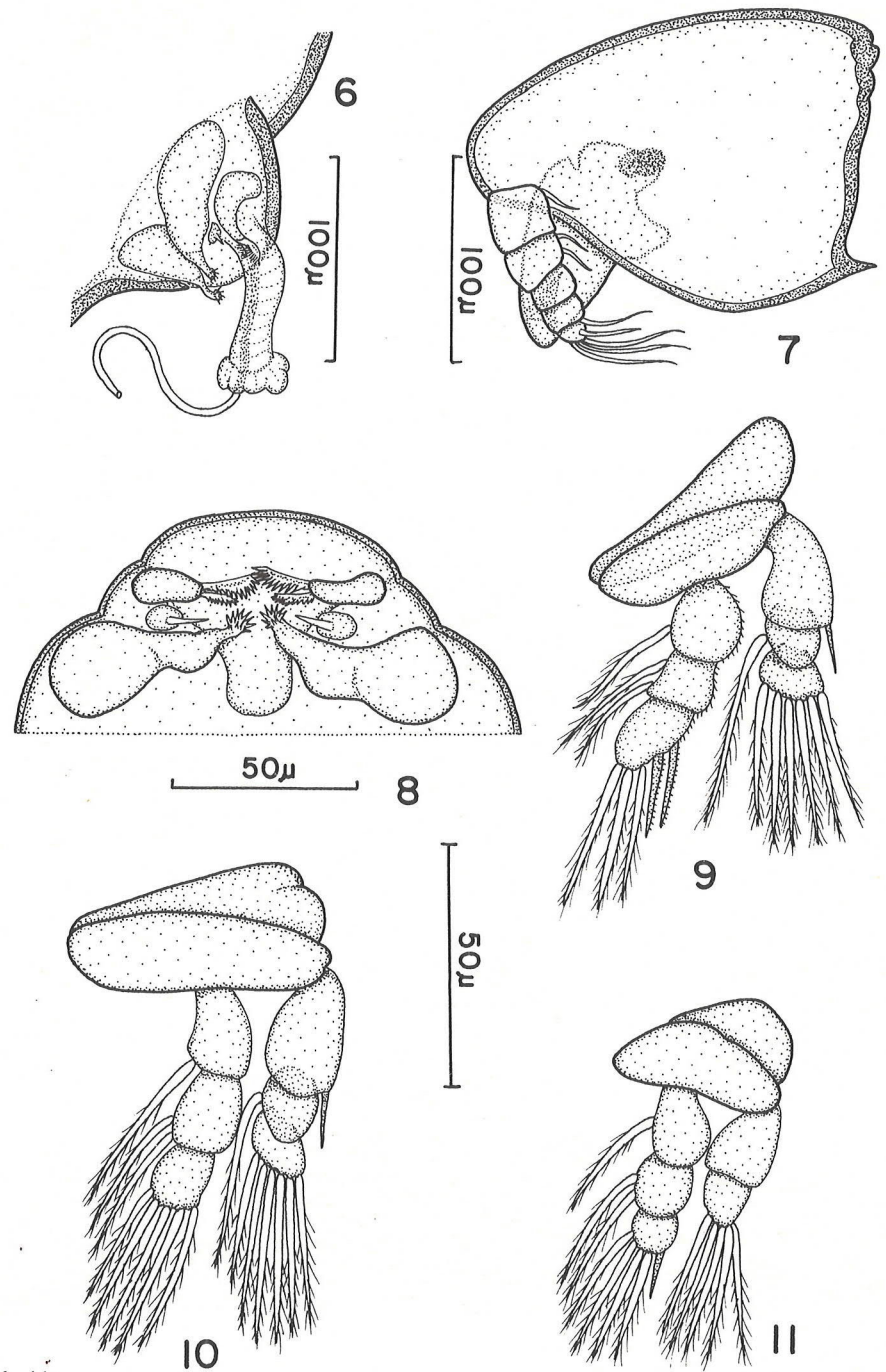
	Length	Width
Antennule	80 - 100 (90)	25 - 30 (28)
Antenna		
Segment 1	47 - 62 (57)	50 - 55 (51)
2	50 - 75 (64)	40 - 50 (46)
3	55 - 65 (60)	30 - 42 (33)

Table 3: Relationship of spines to setae on the legs of *Amazonicopeus elongatus* gen. et sp. nov.

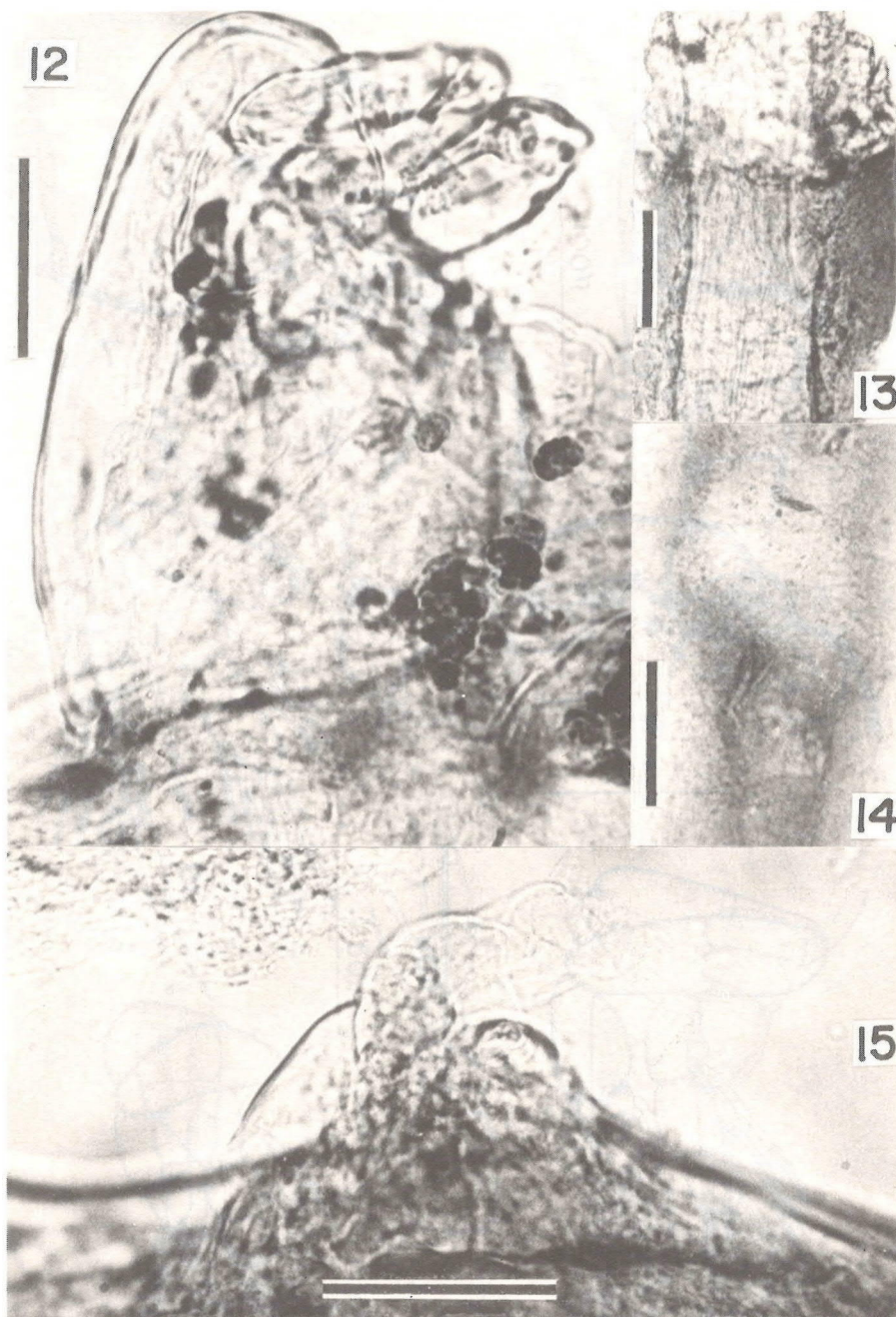
Leg	Endopod	Exopod
1	0 - 1, 0 - 2, II - 3	I - 0, 0 - 1, 0 - 6
2	0 - 1, 0 - 2, 0 - 5	I - 0, 0 - 1, 0 - 6
3	0 - 1, 0 - 2, 0 - 5	I - 0, 0 - 1, 0 - 6
4	0 - 1, 0 - 2, I - 4	0 - 0, 0 - 5



Figs. 1 - 5:
Amazonicopeus elongatus gen. et sp. nov. (post-metamorphic female)
 1: Entire specimen (ventral). 2: Antenna. 3: Hindbody. 4: Antennule. 5: Abdomen and Uropod.



Figs. 6 - 11:
Amazonicopeus elongatus gen. et sp. nov. (post-metamorphic female)
 6: Mouthparts (lateral). 7: Head. 8: Mouthparts (ventral). 9: Leg 1. 10: Leg 2 (= Leg 3). 11: Leg 4.



Figs. 12 - 15:

Amazonicopeus elongatus gen. et sp. nov. (post-metamorphic female)

12: Head and antennae. 13: Encapsulated neck (calcified above and fibrous below). 14: Encapsulated neck (upper part destroyed). 15: Mouth-tube (labrum to left and labium to right).

Scale bars: 12 & 15 = 50 μ m; 13 & 14 = 100 μ m.